

What is claimed is:

1. A motor braking circuit, comprising a braking power switching device coupled across windings of a motor that is repeatedly cycled open and closed to brake the motor.

2. The motor braking circuit of claim 1 wherein the braking power switching device is a FET.

3. The motor braking circuit of claim 2 wherein the FET is a MOSFET.

4. The motor braking circuit of claim 2 and further including a controller coupled to the FET that upon power to the motor being disconnected generates a sequence of pulses to switch the FET on and off.

5. The motor braking circuit of claim 4 wherein the controller includes a timer for generating the sequence of pulses.

6. The motor braking circuit of claim 5 wherein the controller includes an adjustment circuit coupled to the timer for adjusting at least one of a duty cycle and a frequency of the sequence of pulses output by the timer.

7. The motor braking circuit of claim 6 wherein the sequence of pulses comprises a pulse width modulated signal.

8. The motor braking circuit of claim 5 and further including a storage capacitor that is charged when power is connected to the motor and that provides power to the motor braking circuit when power to the motor is disconnected.

9. The motor braking circuit of claim 2 wherein an internal diode of the FET is used in lieu of a separate diode across the windings of the motor.

10. The motor braking circuit of claim 1 and further including a controller for repeatedly cycling the braking power switching device open and closed when a switch that activates the motor when closed is opened.

11. The motor braking circuit of claim 10 and further including a storage capacitor that is charged when power is connected to the motor and that provides power to the motor braking circuit when power to the motor is disconnected.

12. The motor braking circuit of claim 10 wherein the switch provides a signal to the controller based on how far the switch is depressed, the controller controlling the speed of the motor in response to the signal provided by the switch.

13. The motor braking circuit of claim 1 wherein the motor is a DC motor.

14. The motor braking circuit of claim 13 wherein the DC motor is a permanent magnet DC motor.

15. The motor braking circuit of claim 1 wherein the motor is a mains powered motor.

16. A motor braking circuit, comprising:

a FET coupled across windings of a motor;

a controller coupled to the FET that, upon the motor being switched off, generates a sequence of pulses that switch the FET on and off to brake the motor; and

a storage capacitor that is charged when power to the motor is switched on and that provides power for the motor braking circuit when power to the motor is switched off.

17. The motor braking circuit of claim 16 wherein the FET includes an internal diode coupled across the windings of the motor that acts as a free wheeling diode and is used in lieu of a separate free wheeling diode.

18. The motor braking circuit of claim 16 wherein the controller outputs a free running pulsating signal to the braking power switching device.

19. The motor braking circuit of claim 18 wherein the free running pulsating signal is a pulse width modulated signal.

20. The control circuit of claim 18 wherein the free running pulsating signal is a square wave.

21. The motor braking circuit of claim 16 wherein the controller controls braking of the motor by varying at least one of a duty cycle and frequency of a pulse width modulated signal that the controller outputs to the braking power switching device.

22. A control circuit for a motor, comprising a switch for activating the motor when the switch is on, a controller, a braking power switching device coupled across windings of the motor and coupled to the controller, the controller cycling the braking switching device open and closed to brake the motor when the switch is switched off.

23. The control circuit of claim 22 wherein the motor is a DC motor and the switch connects the motor to a source of DC power to activate the motor when the switch is on and disconnects the motor from the source of DC power to deactivate it when the switch is off, and further including a storage capacitor that is charged when the switch is on and provides power for the controller and the braking power switching device when the switch is off.

24. The control circuit of claim 23 wherein the braking power switching device includes a semiconductor switch.

25. The control circuit of claim 24 wherein the semiconductor switch includes a FET having an internal diode coupled across the windings of the motor, the internal diode of the FET acting as a free wheeling diode and used in lieu of a separate free wheeling diode.

26. The control circuit of claim 25 wherein the FET is a MOSFET.

27. The control circuit of claim 25 wherein the semiconductor switch includes at least one of a triac, SCR, MOSFET, IGBT and Darlington pair.

28. The control circuit of claim 22 wherein the motor is a mains powered motor.

29. The control circuit of claim 22 wherein the motor is a DC motor coupled to a battery, the motor remaining connected to the battery when the switch is off deactivating the motor so that power generated during braking the motor recharges the battery at least in part.

30. The control circuit of claim 22 wherein the switch is a trigger switch housed in a module that also houses the braking power switching device.

31. The control circuit of claim 22 wherein the controller controls braking of the motor by varying at least one of a duty cycle and frequency of a pulse width modulated signal that the controller outputs to the braking power switching device.

32. The control circuit of claim 31 wherein the controller senses at least one of motor speed and back emf of the motor and controls braking of the motor based on the at least one of motor speed and back emf of the motor.

33. The control circuit of claim 22 wherein the controller outputs a free running pulsating signal to the braking power switching device.

34. The control circuit of claim 33 wherein the free running pulsating signal is a pulse width modulated signal.

35. The control circuit of claim 33 wherein the free running pulsating signal is a square wave signal.

36. The control circuit of claim 22 wherein the switch is a trigger switch that provides a signal to the controller based on how far the switch is depressed, the controller controlling the speed of the motor in response to the signal provided by the trigger switch.

37. The control circuit of claim 36 wherein the trigger switch includes a potentiometer that provides the signal to the controller based on how far the switch is depressed.

38. A power tool, comprising:  
a housing surrounding a motor;  
a switch for activating the motor when the switch is on;  
a controller; and  
a braking switching device coupled across windings of the motor and coupled to the controller, the controller cycling the controllable switching device open and closed to brake the motor when the switch is switched off.

39. The power tool of claim 38, wherein the braking switching device includes a semiconductor switch.

40. The power tool of claim 39 wherein the semiconductor switch includes a FET having an internal diode coupled across the windings of the motor, the internal diode of the FET acting as a free wheeling diode and used in lieu of a separate free wheeling diode.

41. The power tool of claim 39 wherein the semiconductor switch includes at least one of a triac, SCR, MOSFET, IGBT and Darlington pair.

42. The power tool of claim 39 wherein the switch is a trigger switch housed in a module, the braking switching device also housed in the module.

43. The power tool of claim 42 wherein the switch is a trigger switch having a potentiometer that provides a signal to the controller based on how far the switch is depressed, the controller controlling the speed of the motor in response to the signal provided by the potentiometer.

44. The power tool of claim 42 wherein the motor is a DC motor and the switch connects the motor to a source of DC power to activate the motor when the switch is on and disconnects the motor from the source of DC power to deactivate it when the switch is off.

45. The power tool of claim 42 wherein the motor is a mains powered motor.



46. The power tool of claim 39 and further including a battery and a storage capacitor, the motor comprising a DC motor that is coupled to the battery when the switch is on and decoupled from the battery when the switch is off, the storage capacitor being charged by the battery when the switch is on and providing power to the controller and semiconductor switch when the switch is off.

47. A method of braking a motor, comprising cycling a braking switching device coupled across windings of the motor open and closed to brake the motor.

48. The method of claim 47, wherein cycling the braking switching device open and closed includes switching a semiconductor switch coupled across the windings of the motor on and off.

49. The method of claim 48, wherein switching the semiconductor switch on and off includes pulsing it with a pulsating signal.

50. The method of claim 49, wherein pulsing the semiconductor switch includes pulsing it with a pulse width modulated signal and varying at least one of a duty cycle and frequency of the pulse width modulated signal to vary at least one of a braking speed and braking current.

51. In a cordless power tool having a permanent magnet DC motor, a switch that activates the motor when switched on and deactivates the motor when switched off, a method of braking the motor, comprising switching a semiconductor switch coupled across the windings of the motor on and off to brake the motor.

52. The method of claim 51 and further including charging a storage capacitor when the switch is on and providing power to the semiconductor switch from the storage capacitor when the switch is switched off.

53. The method of claim 52 wherein the electronic switch is a MOSFET having an internal diode coupled across the windings of the motor, the method further including using the internal diode of the MOSFET as a free wheeling diode in lieu of a separate free wheeling diode.

54. In a power tool having a mains powered motor, a switch that activates the motor when switched on and deactivates the motor when switched off, a method of braking the motor, comprising switching a semiconductor switch coupled across the windings of the motor on and off to brake the motor.

55. The method of claim 54 and further including charging a storage capacitor when the switch is on and providing power to the semiconductor switch from the storage capacitor when the switch is switched off.

56. The method of claim 55 wherein the electronic switch is a MOSFET having an internal diode coupled across the windings of the motor, the method further including using the internal diode of the MOSFET as a free wheeling diode in lieu of a separate free wheeling diode.